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(71) Applicant
Precision Metal Forming Limited,
(United Kingdom),
Swindon Road, Cheltenham

(72) Inventor
Brian George Smith

(74) Agent and/or Address for Service
A. R. Davies & Co.,
27 Imperial Square, Cheltenham

(54) Improvements in structural frames

(57) A steel frame for a building is made up from panels connected together at the corners of the frame by elongate corner connectors 74 Figure 1d having a cross-section comprising a central web 24 and two parallel flanges 26 and 28 extending along opposite edges of the web 24. The flange 28 is formed with an outwardly projecting lip 30, and the flange 26 projects a greater distance from the web 24 than the flange 28. A first frame panel is connected to the web 24 and extends in the opposite direction to that in which the flanges 26, 28 project, and a second frame panel is connected both to the lip 30 and to the flange 26 and extend in the direction in which the lip 30 projects. Furthermore the panels are connected to intermediate portions of other panels by joint connectors 82 Figure 1e having a cross-section comprising a central web 36 and two parallel flanges 38 and 40 formed with outwardly projecting lips 42 and 44. The lips 42 and 44 are connected to the intermediate portion of the panel to which the connection is to be made, and the other panel is connected to the web 36.

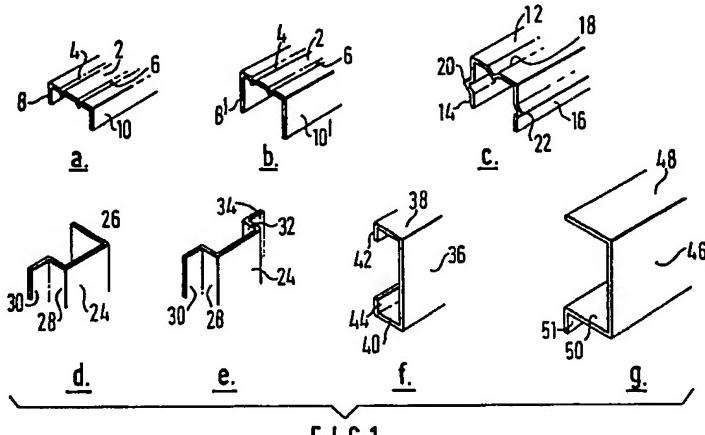
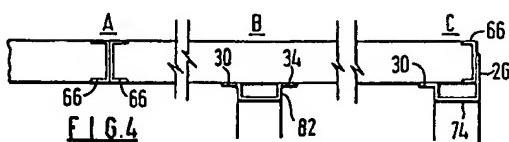
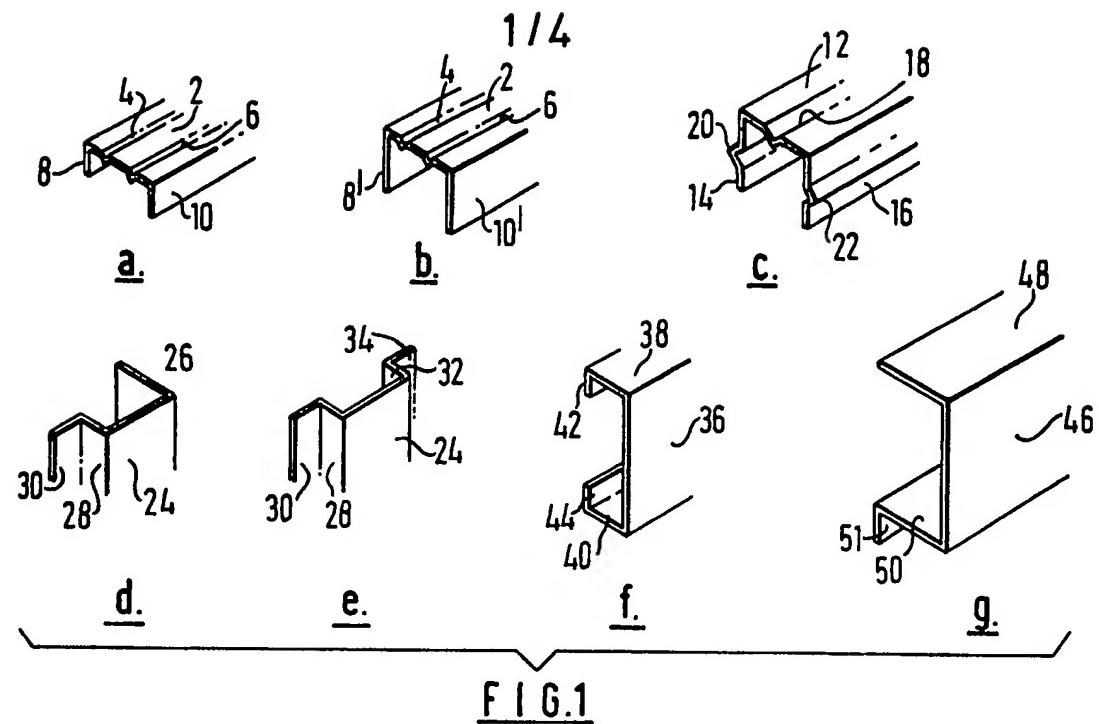


FIG. 1

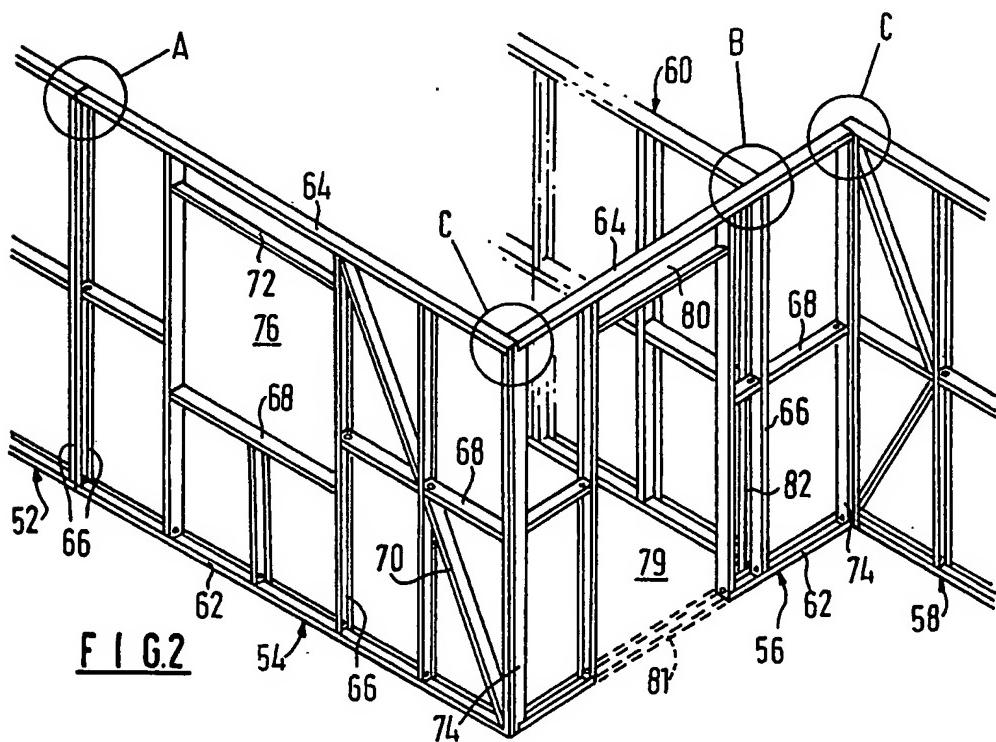


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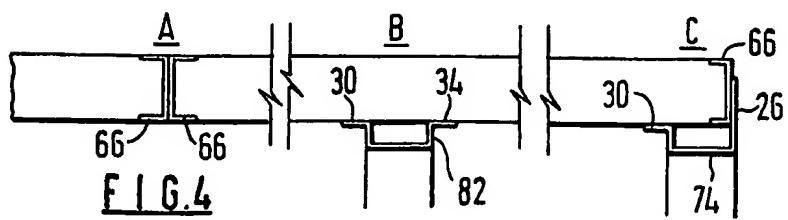
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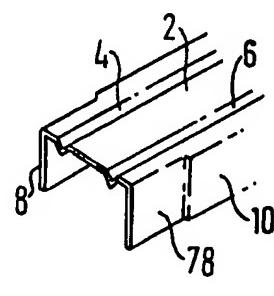
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F I G.2



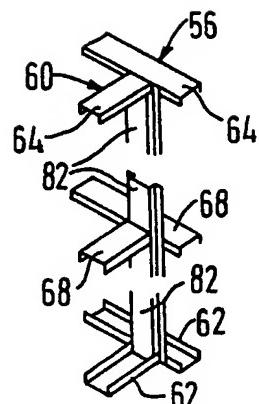
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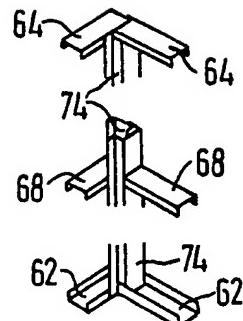
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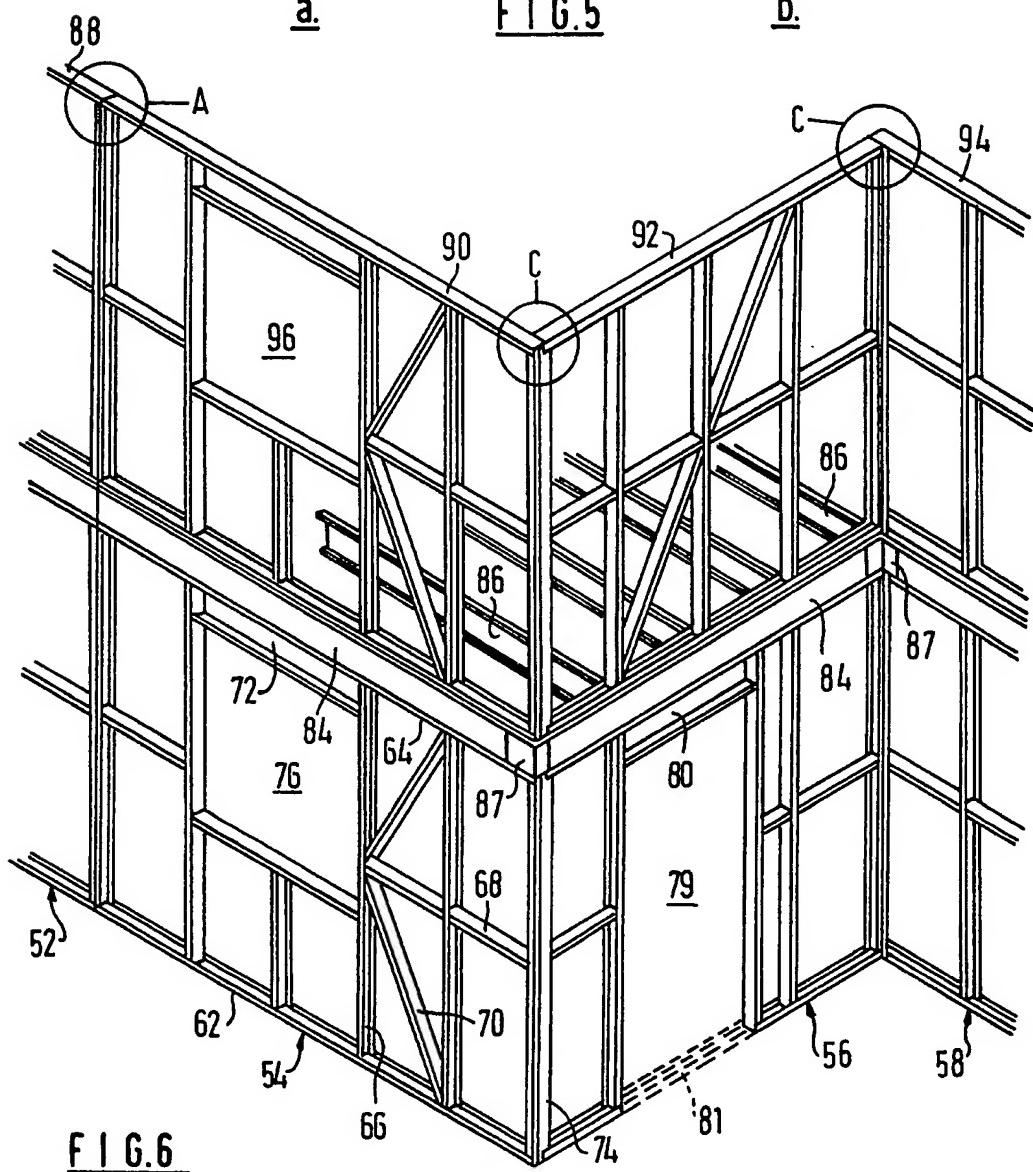


a.



b.

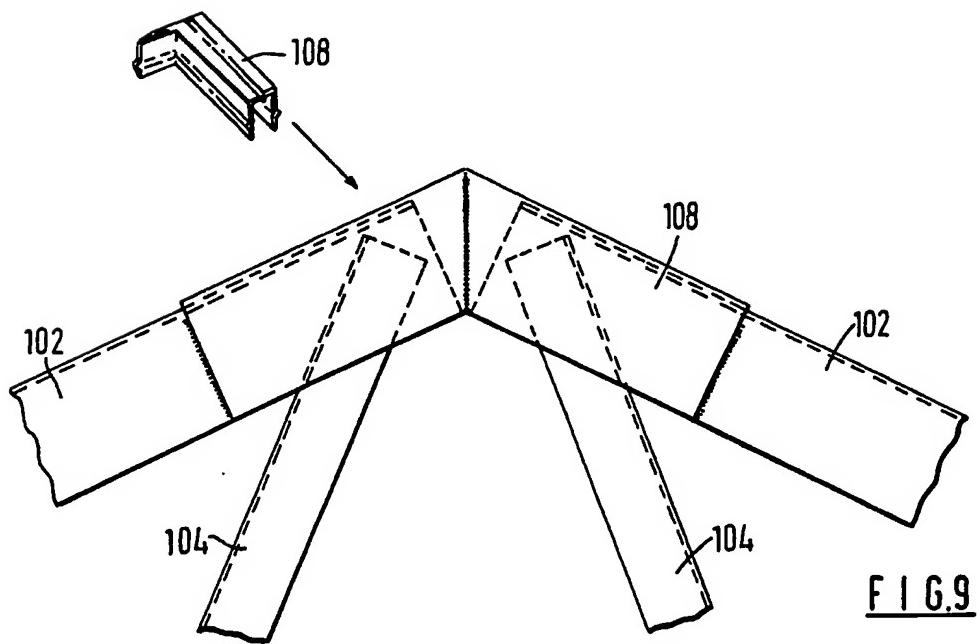
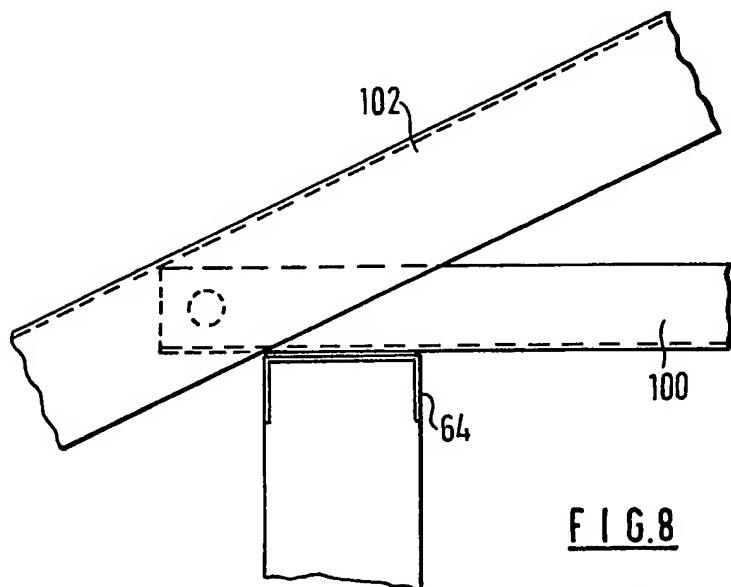
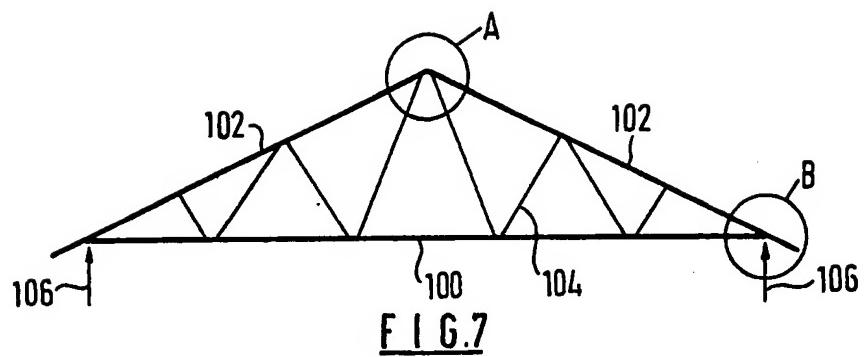
F I G . 5



F I G . 6

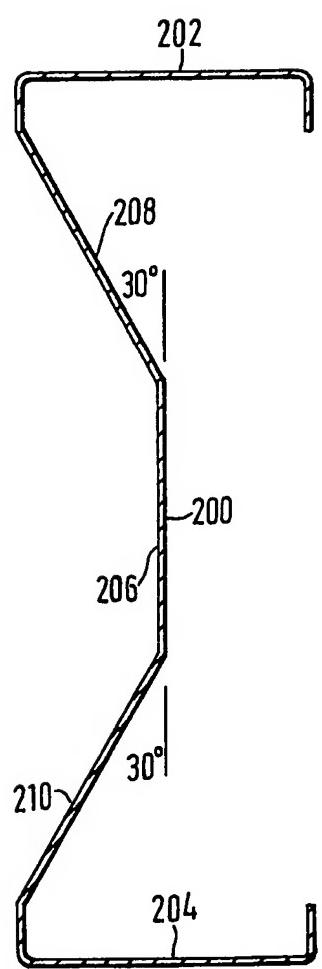
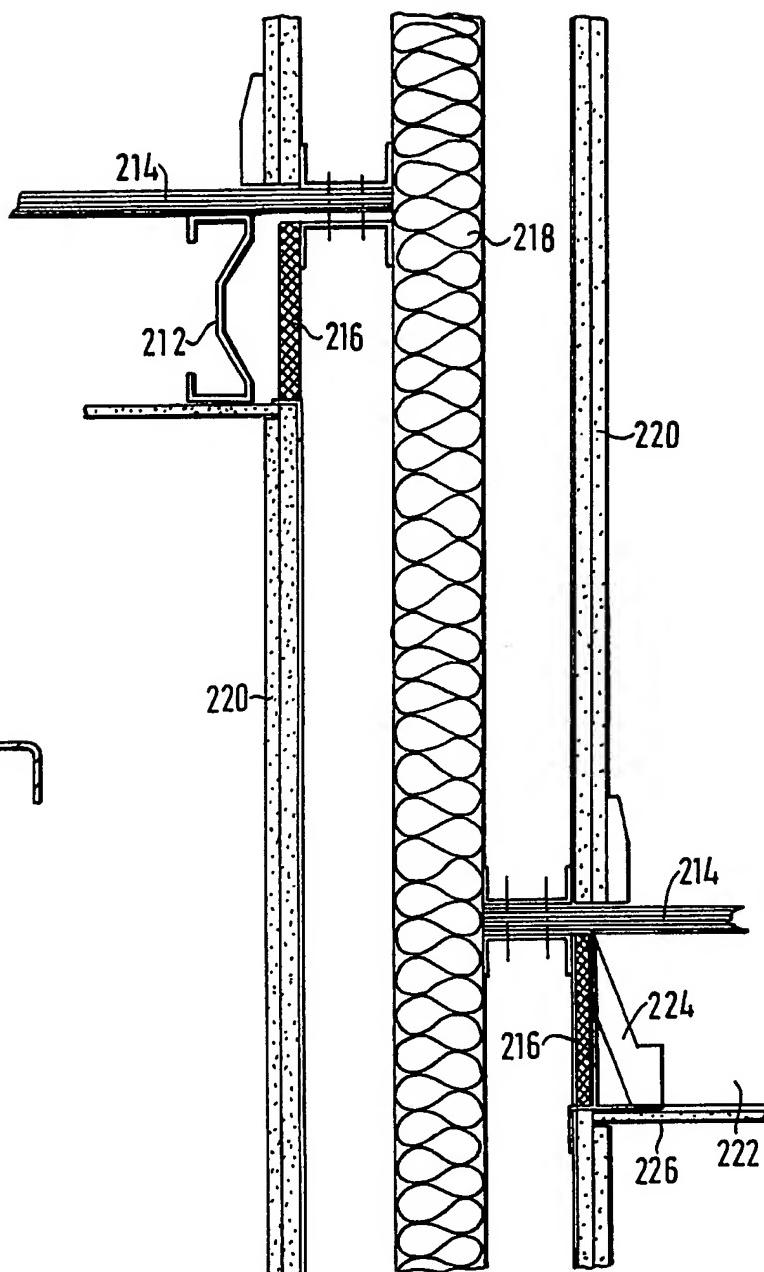
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F I G.10

F I G.11

SPECIFICATION

Improvements in structural frames

5 This invention relates to structural frames, and is more particularly, but not exclusively, concerned with galvanised steel frames for buildings.
 Increasing interest is being shown in the use of zinc coated (galvanised) steel framing for home
 10 building. Once the steel frame has been erected on a sub-floor, it may be lined internally and externally with suitable materials, with thermal insulating material being interposed between these linings if desired, and the required external claddings, such as
 15 brickwork and/or timber boarding, may be constructed around the frame. Such a method of construction possesses a number of advantages over more traditional methods of home construction in that the steel frame provides high strength and
 20 stability, so that call back maintenance due to shrinkage or warping of building materials is virtually eliminated and the risk of damage in the case of settlement is minimised. Moreover the use of such frames considerably reduces the overall building
 25 time.

The present invention has as its object to provide a frame suitable for this purpose which includes a number of novel and highly advantageous features.

The invention provides a frame incorporating first
 30 and second frame panels connected together along adjacent edges of the panels by an elongate corner connector having a cross-section comprising a central web and two parallel flanges extending along opposite edges of the web and defining a channel therewith, a first of these flanges being formed with an outwardly projecting lip and the second of these flanges projecting a greater distance from the web than the first flange, wherein the first frame panel is connected to the web of the corner connector and
 35 extends in the opposite direction to the direction in which the flanges project from the web, and the second frame panel is connected both to the lip and to the second flange of the corner connector and extends in the direction in which the lip projects
 40 from the first flange.

Such an arrangement provides a particularly rigid connection between the panel members. Moreover the connector is substantially flush with both panels on either side of the panels, thus enabling a flat
 50 sheet or board laid over either side of one of the panels to extend right up to the corner. The corner connector may extend along substantially the complete length of the adjacent edges of the panels and may itself form an integral part of one of the panels.
 55 For example, the corner connector may form part of the first panel which may also include one or more cross members connected at their ends to the web of the corner connector and extending in the opposite direction to the direction in which the flanges project
 60 from the web. In this case the second panel preferably incorporates an elongate edge member which extends along substantially the complete length of the adjacent edge of that panel, and the connection between the two panels is effected by connecting the
 65 edge member both to the lip and to the second

flange of the corner connector of the first panel.

The invention further provides a frame incorporating a first frame panel which is connected along one edge to an intermediate portion of a second frame

70 panel by an elongate joint connector having a cross-section comprising a central web and two parallel flanges extending along opposite edges of the web and defining a channel therewith, each of the flanges being formed with a respective outwardly projecting lip, wherein the first frame panel is connected to the web of the joint connector and extends in the opposite direction to the direction in which the flanges project from the web, and the second frame panel is connected to both lips of the
 75 joint connector and extends generally parallel to these lips.

Such an arrangement possesses similar advantages to the arrangement previously described, being adapted particularly to the joining together of two
 80 panels where an edge of one panel is to abut one side of the other panel. The joint connector may form an integral part of the first frame panel.

In order that the invention may be more fully understood, reference will now be made, by way of
 90 example, to the accompanying drawings, in which:

Figure 1 shows various structural members which are used in the construction of frames in accordance with the invention;

Figure 2 shows a portion of a single storey frame
 95 in accordance with the invention;

Figure 3 shows the crimped end of a structural member of the frame of *Figure 2*;

Figures 4 and 5 diagrammatically illustrate the form of several joints used in the frame of *Figure 2*;

100 *Figure 6* shows a portion of a two storey frame in accordance with the invention;

Figure 7 is a diagrammatic representation of a roof truss in accordance with the invention; and

Figures 8 and 9 show details of the roof truss of
 105 *Figure 7*.

The building frames which are illustrated in the drawings are constructed from galvanized steel members having sections as shown in *Figure 1*, the dimensions being shown in this figure in millimetres. The section which is used for most of the structural members of the frame is shown at (a), and comprises a central web 2 having parallel ribs 4 and 6 extending along its length and two parallel flanges 8 and 10 extending along opposite edges of the web

110 2 and projecting in the same direction as the ribs 4 and 6. This section is used more particularly for the studs, noggins, bottom plates, top plates and bracing plates of the wall panels, as well as for the struts, ties and bracing plates of the roof trusses. A similar

115 section having longer flanges 8' and 10', shown at (b), is used for the bottom chord of the roof trusses, and optionally also, as an alternative to the section (a), for the bottom plates of the wall panels. The top chord of the roof trusses has a section shown at (c)

120 which comprises a central web 12 and two parallel flanges 14 and 16 extending along opposite edges of the web 12, the web 12 being formed with an inwardly projecting rib 18 and the flanges 14 and 16 being formed with outwardly projecting ribs 20 and
 125 22.

The section which is used for the corner studs of the wall panels is shown at (d) in Figure 1 and comprises a central web 24, a first flange 26 extending along one edge of the web 24 and a second, shorter flange 28 extending along the opposite edge of the web 24 and formed with an outwardly extending lip 30 parallel to the web 24. A similar section, but having the first flange 32 also formed with a lip 34 parallel to the web 24, is shown at (e) and is used as a junction stud for the wall panels. The floor joists and window and door lintels have a section as shown at (f) comprising a central web 36 and flanges 38 and 40 formed with inwardly extending lips 42 and 44. Finally a G-section top plate is shown at (g) which comprises a central web 46, a first flange 48 and a second flange 50 formed with an outwardly extending lip 51.

The manner in which certain of these structural members may be combined to form the frame of a single storey building will now be described with reference to Figure 2 which shows a portion of the fully erected frame. The structural members will generally be prefabricated to form panels which may be joined together on site. Five such panels 52, 54, 56, 58 and 60 are shown at least partly in Figure 2. Considering the panel 54 by way of example, this panel 54 comprises a bottom plate 62, a top plate 64, studs 66, noggin 68 and bracing plates 70, all of which have a section as shown at (a) in Figure 1, and in addition a window lintel 72 having a section as shown at (f) in Figure 1. The panel 54 includes a window opening 76. The ends of the studs 66, noggin 68 and bracing plates 70 are crimped as shown at 78 in Figure 3 so as to enable these ends to fit within the channels in the bottom plate 62, top plate 64, studs 66 and noggin 68 where appropriate and to bear against the ribs 4 and 6 within these channels. The crimped ends are fixed within the channels by appropriately positioned fillet or spot welds, the ribs 4 and 6 providing firm support for the members and thus relieving the welds from stress. The joints between the ends of the noggin 68 or the window lintel 72 and the backs of the channel-shaped studs 66 are also made by welding, although the use of joining brackets may be required where spot welds are used. The panel 56 is formed in a generally similar manner to the panel 54 although in this case the panel includes a door opening 79 and a door lintel 80 which is generally similar to the window lintel 72, and two corner studs 74 having sections as shown at (d) in Figure 1.

The panels are joined together on site by welding, bolting, riveting or screwing and are fixed to the subfloor by appropriate fasteners extending through the bottom plates 62. A section 81 of the bottom plate 62 of the panel 56 is cut out after the frame has been erected.

The manner in which the panels are fixed together will now be described with reference to Figure 4 which shows diagrammatic sectional views through the frame at the positions A, B and C shown in Figure 2. In the lefthand view in Figure 4 the joint at A between the panels 52 and 54 is shown. This joint occurs in a run of wall and is simply achieved by butting the panels 52 and 54 with their endmost

studs 66 back to back and fixing these two studs 66 together. Alternatively such a joint may be made by extending the bottom and top plates 62 and 64 of the two panels 52 and 54 and joining the bottom plates 70 together and the top plates together by means of an appropriately shaped joining plate. In the middle view in Figure 4, the joint at B between the panels 60 and 56 is shown. This joint is made by means of a joint stud 82, having a section as shown at (e) in Figure 1, provided on the end of the panel 60, in a similar manner to the corner studs 74 provided at the ends of the panel 56. In this case the connections are made between the outwardly extending lips 30 and 34 of the joint stud 82 and the adjacent stud 66 of the panel 56, as well as to the bottom and top plates 62 and 64 and the adjacent noggin 68 of the panel 56 as will be appreciated by referring to Figure 5 (a) in which the connections at the top, middle and bottom of the joint stud 82 are shown for the case where the adjacent stud 66 of the panel 56 is omitted. In the righthand view of Figure 4, the corner joints at C between the panels 54 and 56 and between the panels 56 and 58 are shown. In this case the connections are made between the flange 26 of the corner stud 74 and the adjacent stud 66 of the panel 54 or 58 and the outwardly extending lip 30 of the corner stud 74 and the bottom plate 62, top plate 64 and adjacent noggin 68 of the panel 54 or 58. Such connections are shown in Figure 5 (b) in which the top, middle and bottom of the corner stud 74 are shown, although it will be appreciated that in this case the corner stud 74 is disposed in an oppositely handed configuration to the corner studs shown in Figure 2.

The manner in which the structural members already described are combined to form the frame of a two storey building will now be described with reference to Figure 6. The lower storey of this frame is first constructed in a similar manner to the single storey frame of Figure 2. Then a respective G-section top plate 84 having a section as shown at (g) in Figure 1 is laid on top of the top plate 64 of each panel such as 52, 54, 56 and 58 so that the lip 51 extends downwardly within the building and fixed thereto by welding, bolting, riveting or screwing, and floor joists 86 having a section as shown at (f) in Figure 1 are fixed within the channels in the appropriate G-section top plates 84. Alternatively the G-section top plates 84 may be incorporated in the panels such as 52, 54, 56 and 58 in place of the top plates 64 during fabrication of the panels. In either alternative the G-section top plates 84 are joined together at the corners of the frame by L-section joining plates 87.

The second storey is then erected on top of the first storey by welding, bolting, riveting or screwing prefabricated wall panels such as 88, 90, 92 and 94, similar in construction to the panels 52, 54, 56 and 58, to the G-section top plates 84, these panels 88, 90, 92 and 94 being joined together at the positions A and C in precisely the same manner as previously described with reference to Figures 4 and 5. The panel 90 incorporates a window opening 96.

A pitched roof may be attached to either of the frames shown in Figures 2 and 6, the roof trusses

being fabricated either from timber or from steel structural members. Figure 7 diagrammatically illustrates a suitable steel roof truss comprising a bottom chord 100 having a section as shown at (b) in Figure 5 1, two top chords 102 having sections as shown at (c) in Figure 1, and a number of bracing plates 104 having a section as shown at (a) in Figure 1. The ends of the bottom chord 100 and the bracing plates 104 are crimped substantially in the manner shown 10 in Figure 3, and the crimped ends are welded within the channels in top chords 102 and the bottom chord 100. The ribs 18 in the top chords 102 and the ribs 4 and 6 in the bottom chord 100 provide support for the crimped ends welded within the channels in the 15 manner previously described. The roof trusses are supported on the walls of the frame at the points denoted by the arrows 106 in Figure 7.

Figure 8 is an enlarged view of a detail B of the roof truss of Figure 7 showing the manner in which 20 the roof truss is supported with the central web of the bottom chord 100 resting on top of the top plate 64 of one of the wall panels. Angle and gusset plates (not shown) are used to fasten the bottom chord 100 to the top plate 64.

25 Figure 9 is an enlarged view of a detail A of the roof truss of Figure 7 showing the manner in which the top ends of the top chords 102 are connected together. For this purpose a special angled top connector 108 is used having a section which is generally similar to the section of the top chords 102 but of larger dimensions so that the ends of the top chords 102 may be received within the connector 108 as a sliding fit and welded therein.

Figure 10 is a novel form of section of sigma shape 35 which may be used in place of the section as shown at (f) in Figure 1 (or may be used in a frame in combination with structural members having such a section). This section comprises a central web 200 and two parallel flanges 202 and 204 extending 40 along opposite edges of the web 200. The central web 200 includes an intermediate portion 206 perpendicular to the flanges 202 and 204 and a respective inclined portion 208 or 210 joining the intermediate portion 206 to each of the flanges 202 and 204. 45 This section is shown in Figure 11 in use as a floor joist 212 supporting a floor 214. Reference numeral 216 denotes a strip of non-combustible material, and 218 and 220 denote respectively a mineral wool and a plasterboard wall.

50 Figure 11 also shows an alternative arrangement for supporting the floor joists to that already described in which G-section top plates as shown at (g) in Figure 1 are used. In this alternative arrangement each floor joist, such as the one shown at 222 55 extending perpendicularly to the wall 220, is supported by a joist hanger 224 of conventional type, for example of the type sold under the trade name Catnic TTL. Reference numeral 226 denotes a ceiling board.

60 In some circumstances, i.e. high wind load areas, the window lintel 72 shown in Figures 4 and 6 may be replaced by a fabricated type lintel known as a Warren Truss lintel.

Reference is made to the Applicants' co-pending 65 Application No.

CLAIMS

1. A structural frame incorporating first and second frame panels connected together along adjacent edges of the panels by an elongate corner connector having a cross-section comprising a central web and two parallel flanges extending along opposite edges of the web and defining a channel therewith, a first of these flanges being formed with an outwardly projecting lip and the second of these flanges projecting a greater distance from the web than the first flange, wherein the first frame panel is connected to the web of the corner connector and extends in the opposite direction to the direction in which the flanges project from the web, and the second frame panel is connected both to the lip and to the second flange of the corner connector and extends in the direction in which the lip projects from the first flange.
2. A frame according to claim 1, wherein the corner connector extends along substantially the complete length of the adjacent edges of the panels.
3. A frame according to claim 1 or 2, wherein the 90 corner connector itself forms an integral part of one of the panels.
4. A frame according to claim 3, wherein the corner connector forms part of the first panel which also includes one or more cross members connected 95 at their ends to the web of the corner connector and extending in the opposite direction to the direction in which the flanges project.
5. A frame according to claim 4, wherein the second panel incorporates an elongate edge member which extends along substantially the complete 100 length of the adjacent edge of that panel, and the connection between the two panels is effected by connecting the edge member both to the lip and to the second flange of the corner connector of the first panel.
6. A structural frame incorporating a first frame panel which is connected along one edge to an intermediate portion of a second frame panel by an elongate joint connector having a cross-section 105 comprising a central web and two parallel flanges extending along opposite edges of the web and defining a channel therewith, each of the flanges being formed with a respective outwardly projecting lip, wherein the first frame panel is connected to the web of the joint connector and extends in the opposite direction to the direction in which the flanges project from the web, and the second frame panel is connected to both lips of the joint connector and extends generally parallel to these lips.
7. A frame according to claim 6, wherein the joint connector extends along substantially the complete 110 length of the adjacent edges of the panels.
8. A frame according to claim 6 or 7, wherein the joint connector forms an integral part of the first frame panel.